

Patterns of Plant Species Abundance and Physical Conditions in Marine Habitats Invaded By The Nonindigenous Cordgrass, *Spartina anglica*, in Puget Sound

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The nonindigenous English cordgrass, *Spartina anglica*, was introduced into northern Puget Sound, Washington, in 1961. The intent of the introduction was to stabilize a dike system and provide forage for cattle at a farm located on the eastern shore of Port Susan Bay (Frenkel 1987). Although the introduction was small at first, *S. anglica* successfully grew and reproduced, creating large infestations along the shoreline habitats of Port Susan Bay, Skagit Bay, Saratoga Passage, and Padilla Bay. Based on 1999 estimates, *S. anglica* has colonized ~3,300 hectares of Puget Sound intertidal habitat and solidly fills ~400 hectares (Hacker and other, in press). Approximately 10% of *S. anglica* in Puget Sound has been removed (herbicides and mowing) by the State of Washington since 1997 (Hacker and others, in press).

We have been studying the pattern of *S. anglica* invasion by quantifying the extent of the spread in Puget Sound and measuring plant abundance and soil characteristics across an intertidal gradient at a number of infested sites. We have found that *S. anglica* invades four different habitat types that include low and high salinity marshes, mudflats, and cobble beaches (Hacker and others, in press). It is most abundant (~200 solid hectares) in low salinity marshes where it forms monocultures in middle intertidal zones, displacing other native plant species. *S. anglica* is moderately abundant (~125 solid hectares) in mudflat habitats where it is most common in the high intertidal zone. It creates a raised marsh habitat by accumulating sediment around its extensive root system and facilitates the establishment of vascular plant species that are not normally present. *S. anglica* is much less abundant in high salinity marshes (~30 solid hectares) and cobble beaches (~5 solid hectares). In high salinity marshes, *S. anglica* is restricted to the lowest intertidal zones where it captures sediment and extends the low marsh edge out into mudflat habitat. At cobble beaches, it grows amongst cobbles and gravel in the high and middle intertidal zones, creating a root mat on top of the substrate that facilitates the growth of vascular plants and algae.

The unusual physiological characteristics of *S. anglica* (see Thompson 1991) allow it to live in a variety of salty and hypoxic soil conditions. In Puget Sound, it lives in soil salinities that range from 15 g/kg to 40 g/kg and redox potentials as low as -300 mV (S. D. Hacker and M. N. Dethier, unpublished data). *S. anglica* can significantly influence soil conditions. Salinity is lower and oxygen content is higher under *S. anglica* plants in all the communities surveyed. Plants shade the soil surface thereby decreasing salinity and oxygenate the soil through the use of aerenchyma tissue (Thompson 1991).

Our work suggests that the nonindigenous cordgrass, *S. anglica*, is changing the nature of Puget Sound shorelines it invades. To improve control strategy and methodology, we are currently exploring the processes and mechanisms controlling the invasion in different habitat types and the mechanisms of re-invasion after removal.

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